

# Modeling Waterfowl Use of British Columbia Estuaries Within the Georgia Basin to Assist Conservation Planning and Population Assessment

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## Abstract

Estuaries are among the most threatened areas in British Columbia owing to continued coastal development, modification, pollution and the potential effects of climate change and they are of critical importance to tens of thousands of wintering waterfowl. There are an estimated 600 estuaries in B.C., but they have yet to be mapped and classified using standardized criteria, and the waterfowl populations they support have yet to be fully assessed. To address these deficiencies, we are developing a spatially explicit model combining a standardized classification of estuaries at the scale of the Georgia Basin with site-specific analyses of waterfowl survey data. The objectives of the model are to:

- (1) Generate a GIS layer of estuaries found within the Georgia Basin, using standardized classification and mapping criteria.
- (2) Determine which physical and habitat attributes best predict waterfowl abundance on estuaries.
- (3) Predict the waterfowl populations likely to occur in estuaries based on their habitat features.

This assessment will provide a GIS reference identifying our conservation interests in estuaries to be used by stakeholders, and it will assist in prioritizing the planning and habitat securement initiatives undertaken by the Pacific Estuary Conservation Program (PECP).

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Estuaries in the Georgia Basin (GB) are among the most threatened areas in British Columbia owing to coastal development, modification, and pollution. The British Columbia Nearshore Habitat Loss Working Group (BCNHLWG) reported that approximately 23% of the nearshore habitat in the GB has been urbanized, and less than 4% of coastal wetlands and estuaries here are protected under federal and provincial legislation (BCNHLWG, *A strategy to prevent coastal habitat loss and degradation in the Georgia Basin*, unpublished document, 2001). Habitat loss associated with rapidly increasing human populations has been substantial in some areas of the Fraser River delta and at estuaries on Vancouver Island (Butler and Campbell 1987; Campbell-Prentice and Boyd 1988).

It is estimated that hundreds of thousands of waterfowl winter in British Columbia, and these populations depend on estuary habitats and ecological processes for survival (Butler et al. 1989; Mahaffy et al. 1994). In the Georgia Basin, Mahaffy et al. (1994) reported that the single greatest threat to shoreline birds was habitat destruction. Thus, the sustainability of waterfowl depends on the conservation of important estuarine habitats that support wintering waterfowl populations.

In B.C., estuarine conservation activities are administered through the Pacific Coast Joint Venture (PCJV), which aims to maintain coastal wetland ecosystems. Under the PCJV, the Pacific Estuary Conservation Program (PECP) is responsible for the securement (i.e. acquisition) or enhancement of estuarine habitats of conservation importance. Since 1986, the PECP has secured an estimated 52,400 hectares of nearshore habitat for the conservation of wetland-dependent wildlife (Michael Dunn, Canadian Wildlife Service, personal communication 2003).

From 2001 to 2003, two projects were undertaken to support future PCJV/PECP habitat conservation initiatives. At the landscape level of B.C., estuaries were located, classified and mapped according to standardized criteria using GIS tools (PECP, unpublished data 2003). To complement this, historical waterfowl survey data collected at B.C. estuaries from 1975-2002 were analyzed to provide site-specific estimates of waterfowl population abundance (Ryder 2003). From these exercises, estimates of estuary size/location and waterfowl population densities at surveyed estuaries in the GB were obtained. The goals of these assessments were to: (a) generate a GIS layer of estuaries found within the GB to provide a landscape foundation necessary for future resource assessments, and (b) provide a biological linkage to support and prioritize ongoing conservation activities to maintain wetland-dependent wildlife (i.e. waterfowl populations) (Ryder 2003).

From these analyses, there are an estimated 65 estuaries present in the GB region of B.C. (Figure 1). Of these, 14 of 65 estuaries (22%) were surveyed for wintering waterfowl. Five estuaries are presently being surveyed by Bird Studies Canada's Coastal Waterbird Surveying (BSC-CWS) volunteer program within the GB (Figure 2). Waterfowl survey data from all GB estuaries were pooled across species and years to derive a grand mean waterfowl baseline density estimate (Figure 3). The baseline density estimate was  $4.3 \text{ birds} \cdot \text{hectares day estuary}^{-1} \pm 0.5$  (95% C.I.). The site-specific waterfowl density estimates for the GB are shown as departures (anomalies) from this grand mean ( $0 = 4.3 \text{ birds} \cdot \text{hectares day estuary}^{-1}$ ). The upper 95% confidence limit has been set as a desired waterfowl target density for estuaries. Of the estuaries surveyed for wintering waterfowl in the GB, 8 of 14 (53%) supported waterfowl densities at or above the desired target density.

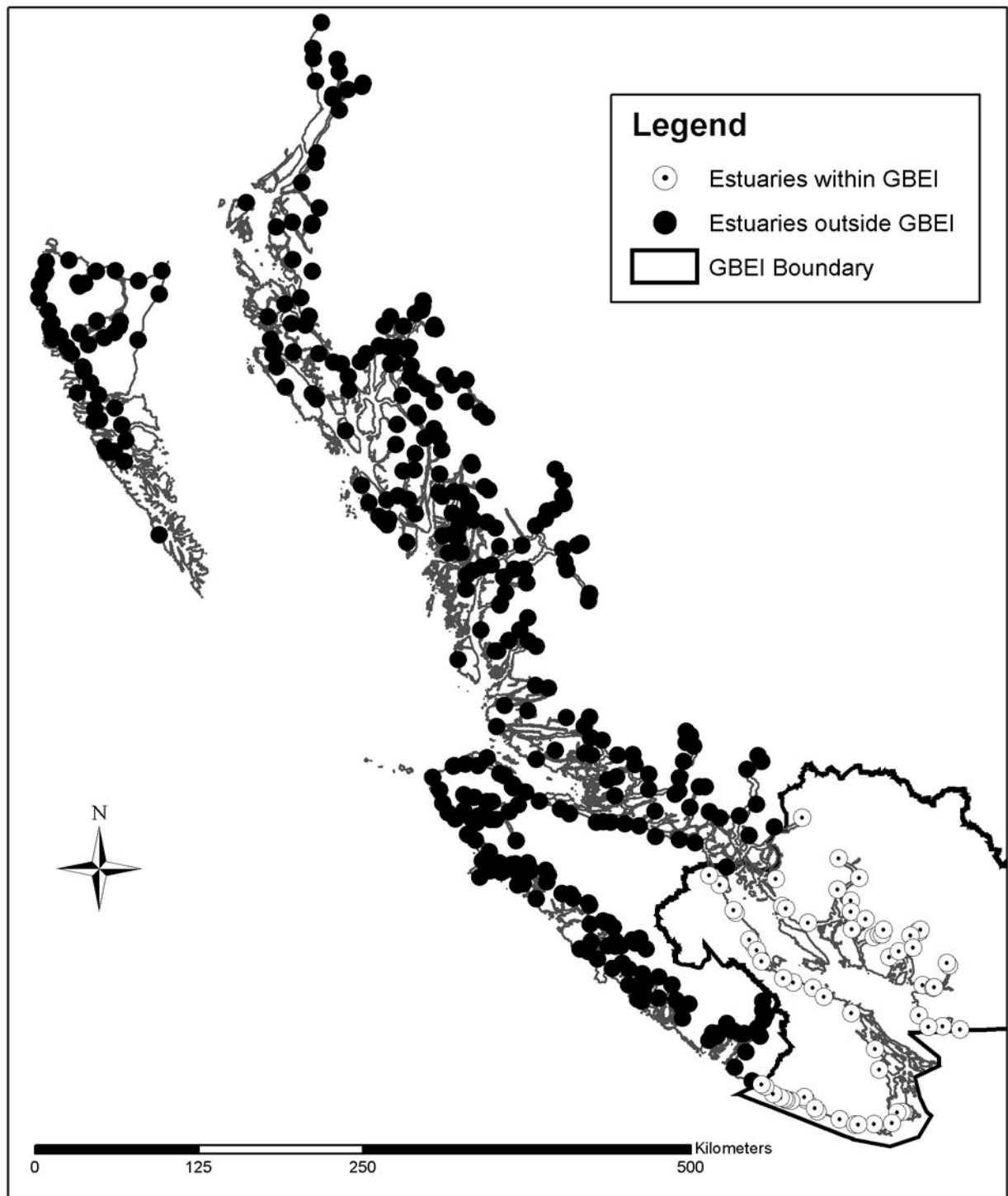
Estuarine landscape and waterfowl population level assessments such as this can provide a scientifically defensible basis for assessing progress toward meeting habitat/population objectives and targets for conservation. Assessments can be used to rank priority habitats for waterfowl populations, to prioritize habitats for securement, to optimally allocate funds for future conservation and monitoring efforts, and to explore options to further evaluate those sites that perform poorly (Ryder 2003). Future waterfowl population assessments should focus on determining which physical and habitat attributes best predict waterfowl abundance on estuaries to further improve conservation planning.

## Acknowledgments

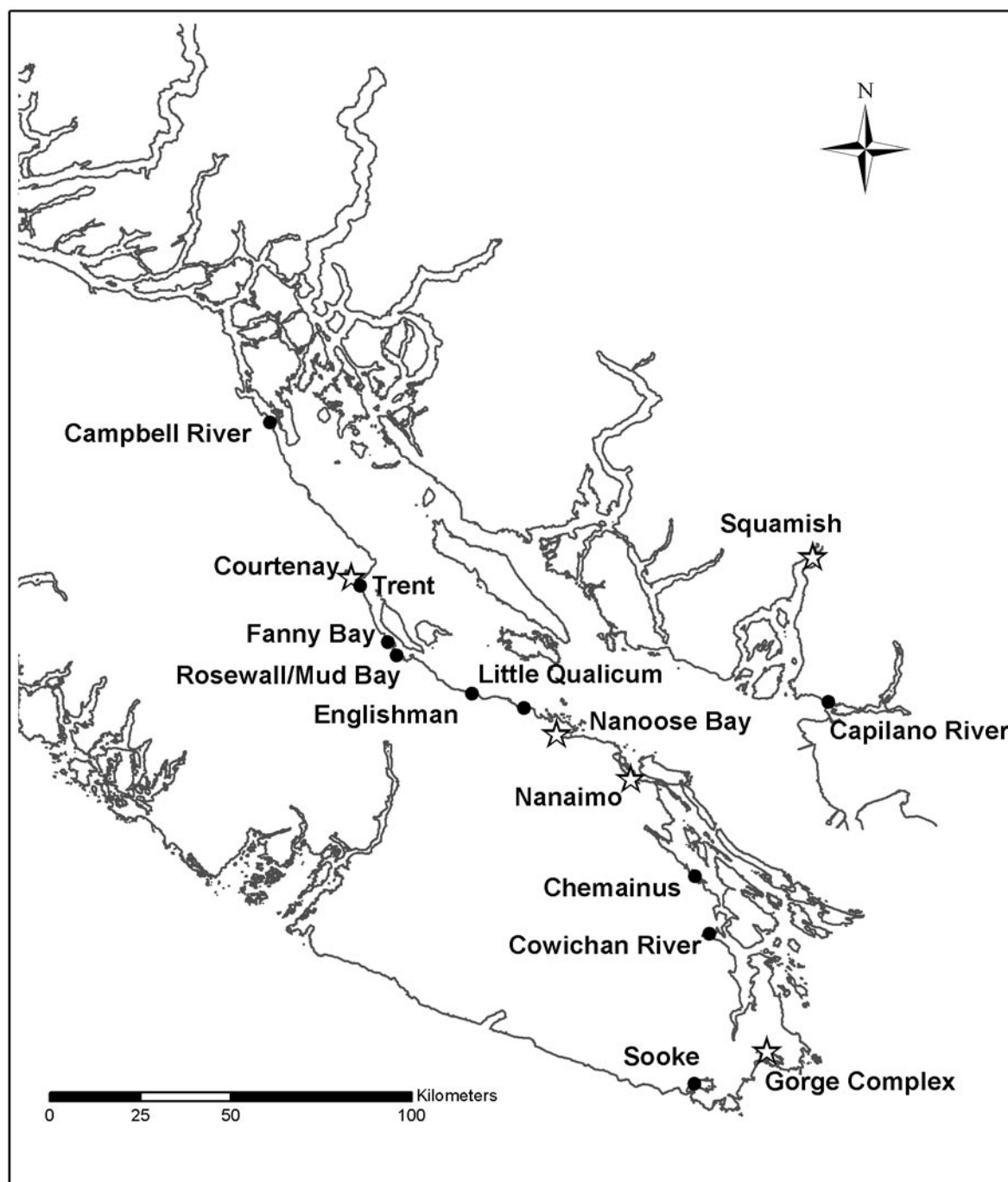
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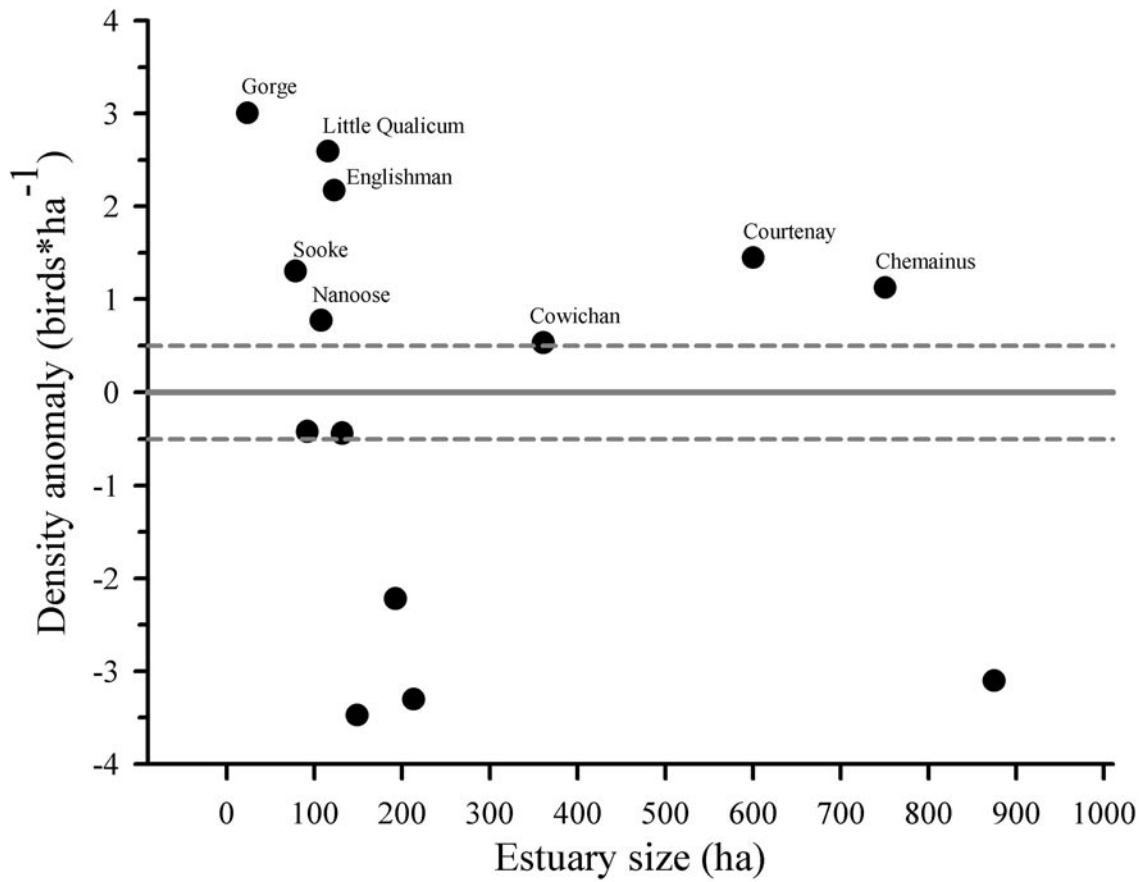
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**Figure 1.** Locations of estuaries (n=65) within the British Columbia portion of the Georgia Basin (thick black line; Environment Canada, map of Georgia Basin Ecosystem Initiative boundary, 2002).



**Figure 2.** Locations of Georgia Basin estuaries with historical waterfowl survey data collected from 1975-2002 (•). The (★) denotes sites being surveyed by Bird Studies Canada's Coastal Waterbird Survey volunteer program as of 2003 (n=5).



**Figure 3.** Waterfowl density anomaly showing the grand mean density (birds\*hectares day estuary<sup>-1</sup>) of waterfowl in the B.C. portion of the Georgia Basin. The estimate is adjusted to 0 (grey line) with 95% confidence interval (dashed grey lines). The upper 95% confidence limit has been set as a desired target.